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EXAMINER

BRYANT, DAVID P

ART UNIT PAPER NUMBER

3726

DATE MAILED: 03/20/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

# Interview Summary

Application No.

10/633,691

Applicant(s)

MINEGISHI ET AL.

Examiner

David P. Bryant

Art Unit

3726

All participants (applicant, applicant's representative, PTO personnel):

(1) David P. Bryant.

(3)\_\_\_\_\_.

(2) David Brown (app's rep).

(4)\_\_\_\_\_.

Date of Interview: 14 March 2006.

Type: a)☒ Telephonic b)☐ Video Conference  
c)☐ Personal [copy given to: 1)☐ applicant 2)☐ applicant's representative]

Exhibit shown or demonstration conducted: d)☒ Yes e)☐ No.

If Yes, brief description: Discussed the English language translation of JP 2000-179544 (attached).

Claim(s) discussed: 1-3 and 6.

Identification of prior art discussed: JP 2000-179544.

Agreement with respect to the claims f)☐ was reached. g)☒ was not reached. h)☐ N/A.

Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: See Continuation Sheet.

(A fuller description, if necessary, and a copy of the amendments which the examiner agreed would render the claims allowable, if available, must be attached. Also, where no copy of the amendments that would render the claims allowable is available, a summary thereof must be attached.)

THE FORMAL WRITTEN REPLY TO THE LAST OFFICE ACTION MUST INCLUDE THE SUBSTANCE OF THE INTERVIEW. (See MPEP Section 713.04). If a reply to the last Office action has already been filed, APPLICANT IS GIVEN A NON-EXTENDABLE PERIOD OF THE LONGER OF ONE MONTH OR THIRTY DAYS FROM THIS INTERVIEW DATE, OR THE MAILING DATE OF THIS INTERVIEW SUMMARY FORM, WHICHEVER IS LATER, TO FILE A STATEMENT OF THE SUBSTANCE OF THE INTERVIEW. See Summary of Record of Interview requirements on reverse side or on attached sheet.



David P. Bryant  
Primary Examiner

Examiner Note: You must sign this form unless it is an Attachment to a signed Office action.

Examiner's signature, if required

## Summary of Record of Interview Requirements

### Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record

A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

### Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews

#### Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

#### 37 CFR §1.2 Business to be transacted in writing.

All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiner's responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicant's correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted,
- 2) an identification of the claims discussed,
- 3) an identification of the specific prior art discussed,
- 4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
- 5) a brief identification of the general thrust of the principal arguments presented to the examiner,  
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
- 6) a general indication of any other pertinent matters discussed, and
- 7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicant's record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

### Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiner's version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, "Interview Record OK" on the paper recording the substance of the interview along with the date and the examiner's initials.

Continuation of Substance of Interview including description of the general nature of what was agreed to if an agreement was reached, or any other comments: Informed Mr. Brown that the translation of JP 2000-179544 had been obtained, and that a copy of the translation will be mailed to him along with this Interview Summary form. The examiner also noted that while the translation does not explicitly set forth how the rolling elements (2) in Figures 1A and 1B of the reference are loaded into the retainer (3), a prima facie case of anticipation has been established based on the disclosed and depicted structure in JP. As noted in paragraph [0013] of JP, the cyclic unit (3a) of the retainer (3), and the inner component (4), are cylindrical in shape. The retainer further includes flanged edges (3b) to maintain the rollers within the retainer. The structure of the retainer is thus essentially the same as that depicted by applicant in Figure 4 of the present application. As further noted in paragraph [0014] of JP, the pockets (5) and (6) formed in the retainer (3) and the inner component (4) are sized smaller than the diameter of the rollers (2) inserted therein to prevent the rollers from passing through the pockets. The overall structure is thus essentially the same as that depicted in Figure 7B of the present application. Since the rollers of JP cannot be inserted through the pockets formed in retainer (3) from the outside due to the smaller size of the pockets, and cannot be inserted from the side of the retainer due to the flanged edges (3b), it is inherent that the only remaining method for inserting the rollers into the retainer is from the inside thereof. It is unclear why applicant has repeatedly pointed to Figure 7 of JP, when it has already been established that Figure 7 depicts a prior art structure that is completely different in structure than the arrangement shown in Figures 1A and 1B of JP.

PTO 06-2379

Japanese Patent  
Document No. 2000-179544

**NEEDLE-SHAPED WHEEL EQUIPPED WITH A RETAINER AND DECELERATING  
DEVICE THAT USES THE SAME**

[Hojiki Tsuki Shinjo Koro Oyobi Kore o Mochiita Gensoku Sochi]

Kazuyoshi Harimoto and Katsushi Abe

UNITED STATES PATENT AND TRADEMARK OFFICE  
Washington, D.C. February 2006

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Abe

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Kore o Mochiita Gensoku Sochi

English Title : NEEDLE-SHAPED WHEEL EQUIPPED WITH  
A RETAINER AND DECELERATING DEVICE  
THAT USES THE SAME

(54) Title of the invention

NEEDLE-SHAPED WHEEL EQUIPPED WITH A RETAINER AND A  
DECELERATING DEVICE THAT USES THE SAME

(57) Summary

Objective: To achieve a high load capacity within a limited space as well as excellent wheel guide functions, strengths, & precision without entailing troubles even in a case where a retainer becomes slid & contacted with an adjacent component on a crank axle (e.g., comet gear, etc.).

Solution mechanism: The present needle-shaped wheel equipped with a retainer possesses not only the retainer (1) comprising of the outer component (3) & inner component (4) but also the wheels (2). The outer component (3) possesses the cyclic unit (3a), the diameter of which is larger than the pitch circle [diameter] (PCD) of a wheel array, and the guard unit (3b), which is provided by bending both ends of the former toward the inner diameter side thereof. The inner component (4) is formed as a cyclic member the diameter of which is smaller than the pitch circle [diameter] (PCD) of a wheel array. The pockets (5) & (6) are configured respectively on the outer & inner components (3) & (4) for housing the wheels (2). The guard unit (3b) may also be configured on the inner component (4) instead of the outer component (3).

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<sup>1</sup> Numbers in the margin indicate pagination in the foreign text.

Claim 1

A needle-shaped wheel equipped with a retainer which possesses not only a retainer comprising of an outer component & an inner component but also wheels, wherein the aforementioned outer component possesses a cyclic unit the diameter of which is larger than the pitch circle diameter of a wheel array and a guard unit provided by bending both ends of said cyclic unit along the axial direction thereof toward the inner diameter side thereof, wherein the aforementioned inner component is formed in a cyclic shape the diameter of which is smaller than the pitch circle diameter of the wheel array, wherein pockets are configured at multiple sites along the respective circumferential directions of the cyclic unit of the aforementioned outer component and said inner component, and wherein the aforementioned wheels are housed within the respective pockets of said outer component & inner component.

Claim 2

A needle-shaped wheel equipped with a retainer which possesses not only a retainer comprising of an outer component & an inner component but also wheels, wherein the aforementioned outer component is formed in a cyclic shape the diameter of which is larger than the pitch circle diameter of a wheel array, wherein the aforementioned inner component possesses a cyclic unit the diameter of which is smaller than the pitch circle diameter of the wheel array and a guard unit provided by bending both ends of said



cyclic unit along the axial direction thereof toward the outer diameter side thereof, wherein pockets are configured at multiple sites along the respective circumferential directions of the aforementioned outer component and the cyclic unit of said inner component, and wherein the aforementioned wheels are housed within the respective pockets of said outer component & inner component.

Claim 3

A needle-shaped wheel equipped with a retainer specified in Claim 1 or 2 characterized by the fact that the member devoid of the guard unit selected from between the aforementioned outer component & inner component possesses a pocket the shape of which coincides with a wheel guide shape.

Claim 4

A needle-shaped wheel equipped with a retainer specified in any of Claims 1 through 3 characterized by the fact that the member devoid of the guard unit selected from between the aforementioned outer component & inner component is provided by curling a belt-shaped sheet and by welding both ends thereof.

Claim 5

A needle-shaped wheel equipped with a retainer specified in any of Claims 1 through 4 characterized by the fact that the member devoid of the guard unit selected from between the aforementioned outer component & inner component consists of a synthetic resin and wherein the member in possession of the guard unit consists of a metallic material.

#### Claim 6

A needle-shaped wheel equipped with a retainer specified in any of Claims 1 through 5 installed in-between the comet gear of a comet gear decelerating device and a crank axle which supports said comet gear.

#### Claim 7

A comet gear decelerating device characterized, with regard to a comet gear decelerating device in possession of a sun gear provided as an inner gear or outer gear, a carrier configured concentrically to said sun gear in a rotatable fashion, a crank axle which is supported, in a rotatable fashion, by said carrier and possesses multiple adjacent eccentric axle units, and multiple comet gears which are installed, via needle-shaped wheels equipped with retainers, on the aforementioned respective eccentric axle units of said crank axle and become engaged with the aforementioned sun gear, by the facts that the aforementioned needle-shaped wheels equipped with retainers are each constituted by a retainer comprising of an outer component & an inner component and multiple wheels which are housed within pockets configured on multiple sites along the respective circumferential directions of said outer component & inner component and are tumbled in-between the aforementioned comet gears & crank axle, that the aforementioned outer component & inner component are constituted respectively by a cyclic unit the diameter of which is larger than the pitch circle diameter of the wheel array and a cyclic unit the diameter of which is smaller than the same, and

that either of said outer component & inner component possesses, at both ends of the aforementioned cyclic unit along the axial direction thereof, a guard unit extended along the diametric direction toward the other component.

#### Detailed explanation of the invention

[0001]

(Technical fields to which the invention belongs)

The present invention concerns a needle-shaped wheel equipped with a retainer capable of yielding the maximal load capacity within a given space as well as a comet gear decelerating device that uses the same.

[0002]

(Prior art)

The all-wheel format is known as a bearing designed to yield the maximal load capacity within a given space, although it is plagued with handling-related problems, namely inferior handling friendliness at the time of assembly & disassembly as well as in-use functional problems attributed to wheel skews. Various needle-shaped wheels equipped with retainers have been proposed in order to solve these problems. It is necessary for a retainer to possess a wheel desorption stopper toward the outer side and a wheel desorption stopper toward the inner side.

[0003]

One example of such a retainer is shown in Figure 7. The retainer (70) shown in the figure bears an M-shaped cross-sectional constitution embodied by the central cyclic unit (71), the diameter of which is smaller than the wheel pitch circle diameter (PCD), the outer cyclic unit (72), the diameter of which is larger the wheel pitch circle diameter (PCD), and the guard units (73) & (73), which are provided by bending [both ends of] the outer cyclic unit (72) toward the inner diameter side. This retainer (70) possesses the outer cyclic unit (72) as an outward desorption stopper for the wheel (74) and the central cyclic unit (71) as an inward desorption stopper for the same. In other words, pockets (75) are formed at symmetric positions of the circumferential directions of the respective cyclic units (71) & (72) for housing the wheels (74), whereas the width of the stopper piece (76) abutting into said pocket (75) is designated to be slightly smaller than the outer diameter of the wheel (74). The wheel (74) is outfitted by elastically deforming, from the outer diameter side, the stopper piece (76) of the pocket (75).

[0004]

(Problems to be solved by the invention)

In a case where the number of wheels (74) integrated with the retainer (70) becomes enlarged within a given space (i.e., under the pervasion of constant inner & outer diameters), the pillar width dimension **a** in Figure 7 (B) becomes reduced, which entails

not only the manifestation of a processing limit but also retainer strength attenuations. For these reasons, a retainer the constitution of which is fundamentally different from that of the retainer (70) instantiated in the figure is required. A retainer guard unit area requirement must, furthermore, be met by a needle-shaped wheel equipped with a retainer designed to intervene in-between the comet gear & crank axle of a comet gear decelerating device. In other words, in a case where a pair of comet gears are installed side-by-side on mutually adjacent eccentric axle units of the crank axle, the guard unit of the retainer becomes slid & contacted with the width plane of the adjacent comet gear in accordance with the eccentric rotations of these eccentric axle units. Unless a certain guard unit area is secured, therefore, an interference with the inner diameter of an adjacent comet gear becomes likely.

[0005]

One objective of the present invention is to provide a needle-shaped wheel equipped with a retainer which is capable of yielding a high load capacity within a given space, which is also excellent in terms of wheel guide functions, strengths, & precision, and which is unaccompanied by troubles even in a case where the retainer becomes slid & contacted with an adjacent components. Another objective of the present invention is to improve productivity by facilitating the formation of a wheel guide plane. Still another objective of the present invention is to provide a comet gear decelerating device which is unaccompanied

by the interference of a needle-shaped wheel equipped with a retainer orchestrated to intervene in-between a comet gear & a crank axle with an adjacent comet gear, which is also excellent in terms of wheel guide functions, strengths, & precision, and /3 which is capable not only of yielding a high load capacity within a given space but also of providing a compact overall device constitution.

[0006]

(Mechanism for solving the problems)

The present invention is fundamentally characterized, with regard to a needle-shaped wheel equipped with a retainer constituted by a retainer & wheels, by the fact that said retainer is constituted by two components, namely an outer component and an inner component, and it additionally bears the following characteristics. The outer component of the needle-shaped wheel of the invention of Claim 1 equipped with a retainer is designed to possess a cyclic unit the diameter of which is larger than the pitch circle diameter of a wheel array and a guard unit provided by bending both ends of said cyclic unit along the axial direction thereof toward the inner diameter side thereof. The inner component is formed in a cyclic shape the diameter of which is smaller than the pitch circle diameter of the wheel array. Pockets are configured at multiple sites along the respective circumferential directions of the cyclic unit of the aforementioned outer component and said inner component, and the

aforementioned wheels are housed within the respective pockets of said outer component & inner component. The outer component of the needle-shaped wheel of the invention of Claim 2 equipped with a retainer is formed in a cyclic shape the diameter of which is larger than the pitch circle diameter of the wheel array. The inner component possesses a cyclic unit the diameter of which is smaller than the pitch circle diameter of a wheel array and a guard unit provided by bending both ends of said cyclic unit along the axial direction thereof toward the outer diameter side thereof. Pockets are configured at multiple sites along the respective circumferential directions of the aforementioned outer component & the cyclic unit of said inner component, and the aforementioned wheels are housed within the respective pockets of said outer component & inner component.

[0007]

Each of the respective inventions of Claims 1 & 2 provides a 2-part retainer constitution comprising of an outer component & an inner component, and since the outward wheel desorption stopper & inward wheel desorption stopper functions can be assigned respectively to the outer component & inner component, the functions of the respective components can be simplified. For this reason, the respective shapes of the outer component & inner component can be simplified, based on which their productions are facilitated, and the processing limit for reducing the width of the pillar portion in-between pockets can be elevated. It therefore becomes possible to maximize the number of wheels within

a given space, and the maximal load capacity can be achieved. Since the respective shapes of the outer component & inner component can be simplified, furthermore, the wheel guide functions also become improved, and excellent effects are achieved in terms of strengths & precisions. In a case where the strength attenuation of the pillar portion of the inner component required to secure a severely limited pillar portion width dimension is unavoidable, in particular, the sheet thickness of the inner component can be designated to be larger than that of the outer component, based on which the degree of freedom for optimal design can be enhanced. It also becomes possible, by configuring, on either the outer component or inner component, a guard unit abutting toward the other component, to secure a sizable area for the guard unit, and therefore, even in a case where a retainer installed on a comet gear support crank axle, etc. becomes slid & contacted with an adjacent component, the trouble of the interference of the retainer with the inner diametric plane of an adjacent component (e.g., comet gear, etc.) can be eliminated.

[0008]

As far as the present invention is concerned, it is also possible for the member devoid of the guard unit selected from between the aforementioned outer component & inner component to possess a pocket the shape of which coincides with a wheel guide shape. In a case where such a wheel guide shape is embodied, the tumbler guide of the retainer becomes possible. Since the wheel guide shape is embodied by the component devoid of the guard unit



in this case, the interference of the guard unit during the formation of the wheel guide shape can be avoided, and the wheel guide shape can be formed with ease.

[0009]

As far as the present invention is concerned, it is also possible for the member devoid of the guard unit selected from between the aforementioned outer component & inner component to be provided by curling a belt-shaped sheet and by welding both ends thereof. Since the member devoid of the guard unit is a simple cyclic unit, it can be easily provided by processing a belt-shaped sheet, and it also becomes possible to minimize the pillar width and to maximize the number of wheels and wheel diameters within a limited space.

[0010]

As far as the present invention is concerned, it is also possible for the member devoid of the guard unit selected from between the aforementioned outer component & inner component to consist of a synthetic resin and for the member in possession of the guard unit to consist of a metallic material. It becomes possible to freely design the shape of a pillar unit comprising of a synthetic resin (e.g., to form a wheel guide plane bearing a shape conforming to the wheel outer diameter, etc.) and to improve the guidability. Since the component made of the synthetic resin is the component devoid of the guard unit, furthermore, the shape of the pillar portion is not limited by the molding of the guard unit. Since the component in possession of the guard unit is made

of a metal, furthermore, sufficient strengths can be secured against the sliding contact force of an adjacent component.

[0011]

As far as the present invention is concerned, it is also possible for the needle-shaped wheel equipped with a retainer bearing each of the aforementioned constitutions to be installed in-between the comet gear of a comet gear decelerating device and a crank axle which supports said comet gear.

[0012]

The comet gear decelerating device of the present invention is characterized, with regard to a comet gear decelerating device in possession of a sun gear provided as an inner gear or outer gear, a carrier configured concentrically to said sun gear in a rotatable fashion, a crank axle which is supported, in a rotatable fashion, by said carrier and possesses multiple adjacent eccentric axle units, and multiple comet gears which are installed, via needle-shaped wheels equipped with retainers, on the aforementioned respective eccentric axle units of said crank axle and become engaged with the aforementioned sun gear, by the fact that the aforementioned needle-shaped wheel equipped with a retainer bears the following constitution. This needle-shaped wheel equipped with a retainer is constituted by a retainer comprising of an outer component & an inner component and multiple wheels which are housed within pockets configured on multiple sites along the respective circumferential directions of said outer component & inner component and are tumbled in-between the

aforementioned comet gears & crank axle. The outer component & inner component are constituted respectively by a cyclic unit the diameter of which is larger than the pitch circle diameter of the wheel array and a cyclic unit the diameter of which is smaller than the same, and either of said outer component & inner component possesses, at both ends of the aforementioned cyclic unit along the axial direction thereof, a guard unit extended along the diametric direction toward the other component. In the case of such a comet gear decelerating device wherein comet gears are installed on a crank axle, it is necessary to prevent the interferences of the needle-shaped wheel equipped with a retainer orchestrated to intervene in-between one comet gear and the crank axle with the inner diameter of an adjacent comet gear. This preventive function is served by the guard unit of the retainer. Within such a comet gear decelerating device, furthermore, a high load is required for supporting the comet gear, and only a limited space is available for the support unit, whereas it becomes possible, by providing the aforementioned retainer divided into two components, namely outer & inner components, to maximize the number of wheels & wheel diameters within such a limited space and to achieve a high load capacity.

[0013]

(Application embodiments of the invention)

/4

The needle-shaped wheel of the first application embodiment of the present invention equipped with a retainer will be explained with reference to Figure 1 & Figure 2. The present needle-shaped wheel equipped with a retainer consists of the retainer (1) and the needle-shaped wheel (2), and the retainer (1) is constituted by the outer component (3) & inner component (4). The outer component (3) possesses the cyclic unit (3a), the diameter of which is larger than the pitch circle diameter (PCD) of a wheel array, and the guard unit (3b), which is provided by bending both ends of said cyclic unit (3a) along the axial direction thereof toward the inner diameter side thereof. The inner component (4) is formed as a cyclic member the diameter of which is smaller than the pitch circle diameter (PCD) of the wheel array. The cyclic unit (3a) of the outer component (3) and the inner component (4) are each characterized by cylindrical shapes, and pockets (5) & (6) are configured, at an equal interval, respectively along the circumferential directions of the outer & inner components (3) & (4). The aforementioned wheels (2) are housed within the respective pockets (5) & (6) of the outer component (3) & inner component (4). The pillar units (7) & (8) are respectively formed in-between mutually adjacent pockets (5) & pockets (6) of the outer component (3) & inner component (4).

[0014]

The outer component (3) corresponding to the member in possession of the guard unit possesses a pocket (5) the width  $m$  of which is slightly smaller than the outer diameter  $D_a$  of the wheel (2) for preventing the outward desorption of the wheel (2). The inner component (4) corresponding to the member devoid the guard unit likewise possesses a pocket (6) the width  $n$  of which is slightly smaller than the outer diameter  $D_a$  of the wheel (2) for preventing the inward desorption of the wheel (2). The pocket (6) of the inner component (4) bears a wheel guide shape. In other words, the inner pocket planes of said pockets (6) on both sides of the circumferential direction are formed as slanted planes (6a) hugging the wheels (2). This slanted plane (6a) is formed by press-punching the pocket (6) according to the illustration of Figure 2 (A) and by pressing the resulting plane with a press, as a result of which the slanted plane (6a) shown in (B) of the same figure becomes formed. The inner component (4), on the other hand, is formed as a cyclic unit by curling a belt-shaped sheet (e.g., steel sheet, etc.) and by welding both ends thereof. The pocket (6) is processed prior to curling. The outer component (3) is a pressed product provided by draw-molding, etc. a metallic sheet (e.g., steel sheet, etc.). The outer component (3), furthermore, is guided along the outer diameter thereof.

[0015]

In a case where the retainer (1) is thus constituted, it becomes possible to house the maximal number of wheels with the maximal diameter within a limited space.

[0016]

Figure 3 shows the second application embodiment. The needle-shaped wheel of the present application embodiment equipped with a retainer is identical to that of the first application embodiment with the exception of the inner component (4A), and therefore, corresponding components are designated to bear identical notations for avoiding overlapping explanations. The inner component (4A) is formed by injection-molding a synthetic resin, whereas the pocket (6A) is formed as the curvy plane (8b) with an arc-shaped cross-sectional constitution trailing along the outer diametrical plane of the wheel (2). The abutting unit (8a) abutting to the outer diameter side from both edges along the width direction is configured on the pillar unit (8A) of the inner component (4A), and the profile plane (8b) of this abutting unit (8a) articulates the aforementioned curvy plane with a cross-sectional arc shape. Incidentally, both profile planes of the pocket (6A) may be formed as curvy planes with cross-sectional arc shapes trailing along the outer diametrical plane of the wheel (2) rather than the abutting unit (8a) alone.

[0017]

Figure 4 shows the third application embodiment. The needle-shaped wheel of the present application embodiment equipped with a

retainer is provided by fundamentally reversing the constitutional order of the outer component (3) & inner component (4) of the first application embodiment. The outer component (3B) is formed as a cyclic unit the diameter of which is larger than the pitch circle diameter (PCD) of the wheel array. The inner component (4B) possesses the cyclic unit (4Ba), the diameter of which is smaller than the pitch circle diameter (PCD) of the wheel array, and the guard unit (4Bb), which is provided by bending both ends of said cyclic unit (4Ba) along the axial direction thereof toward the inner diameter side thereof. The pockets (5B) & (6B) are configured, at an equal interval, at multiple sites along the respective circumferential directions of said outer component (3B) and cyclic unit (4Ba) of the inner component (4B), whereas the wheels (2) are housed within both pockets (5B) & (6B). The inner component (4B) in possession of the guard unit is designed to become guided along the inner diameter thereof (guided by an orbital wheel), whereas the outer component (3B) devoid of the guard unit, wherein the inner plane of the pocket (5B) thereof is formed as the slanted plane (5Ba), is guided via a tumbler.

[0018]

Figure 5 & Figure 6 show an example of comet gear decelerating device to which the needle-shaped wheel of the present invention equipped with a retainer is applied. The present comet gear decelerating device possesses the sun gear (21) provided as an inner gear, the carrier (22) provided as a rotation output unit, the crank axle (23), which is supported, in a

rotatable fashion, by said carrier (22) and possesses multiple adjacent eccentric axle units (23a) & (23b), multiple comet gears (24) & (25), which are configured, in rotatable fashions, on the respective eccentric axle units (23a) & (23b) of the crank axle (23) and engaged with the sun gear (21), and the rotation input unit (26), which inputs a rotating force into the crank axle (23). The sun gear (21) is fixed to the housing (27), whereas the carrier (22) is installed, via the bearing (28) (Figure 6), on the housing (27) in such a way that it can be rotated concentrically to the sun gear (21). The rotation input unit (26) is constituted by the input axle (29), which is concentric to the sun gear (21), and transmission gears (30) configured on the respective crank axles (23) and engaged with the gear portions of the input axle (29). The crank axles (23) are configured at multiple sites (e.g., 3 sites) along the circumferential direction of the carrier (22). The comet gears (24) & (25) are, as Figure 6 indicates, installed, via the respective needle-shaped wheels (31) equipped with retainers, on the eccentric axle units (23a) & (23b) of the crank axles (23). The needle-shaped wheel of the present invention equipped with a retainer, namely any of the aforementioned needle-shaped wheels of the first through third application embodiments equipped with retainers, may be provided as said needle-shaped wheels (31) equipped with retainers.

[0019]

The actions of this comet gear decelerating device will be explained. In a case where the input axle (29) at the center



becomes rotated, three crank axles (23) become rotated in a synchronized fashion via the transmission gears (30). The decelerating action of the first step becomes invoked at this stage. The crank axles (23) are linked to the comet gears (24) & (25) via the needle-shaped wheels (31) equipped with retainers, whereas the vacillations of the crank axles (23) are synchronized with the synthesized motion of the revolutionary & rotational components of a case where the comet gears (24) & (25) are rotated on the inside of the sun gear (21) provided as an inner gear. The pair of comet gears (24) & (25) aligned side-by-side along the axial direction are designed to revolve around the inner circumference of the sun gear (21) provided as an inner gear under the pervasion of a mutual phase differential of  $180^\circ$ . For this reason, the forces of inertia imputed to the vacillations of the pair of comet gears (24) & (25) become mutually cancelled. The sun gear (21) provided as an inner gear is fixed, and the comet gears (24) & (25) revolve around the inner circumference of the sun gear (21) provided as an inner gear. The three crank axles (23) are trapped in-between a pair of disc units (22a) & (22b) of the carrier (22) provided as an output component. The revolutions of the comet gears (24) & (25) therefore become transmitted, via the revolutions of the crank axles (23), to the carrier (22), based on which a decelerated rotating motion becomes obtained.

/5

[0020]

As far as the comet gear decelerating device thus constituted is concerned, high loads become exerted onto the needle-shaped wheels (31) equipped with retainers orchestrated to intervene in-between the comet gears (24) & (25) and the crank axles (23), and furthermore, a limited space is provided as the installation space for said wheels (31) equipped with retainers for avoiding the enlargement of the entire decelerating device. Said needle-shaped wheels (31) equipped with retainers, furthermore, are slid & contacted with the respective width planes of adjacent comet gears (24) & (25). According to the needle-shaped wheel of each of the aforementioned application embodiments equipped with a retainer, however, a high load capacity can be achieved within a limited space. Since either the outer component (3) or inner component (4) possesses a guard unit (3b) abutting toward the other component, furthermore, no problem of interferences with the respective inner diameter planes of the comet gears (24) & (25) becomes incurred even in a case where sliding actions are invoked in relation to the respective width planes of the mutually adjacent & eccentric comet gears (24) & (25).

[0021]

(Effects of the invention)

The retainer of the needle-shaped wheel of the present invention equipped with a retainer is constituted by a pair of mutually independent components, namely outer & inner components,

and since outward & inward wheel desorption preventive functions are assigned to the respective components, it becomes possible to facilitate production, to alleviate the processing limit, and, by enlarging the number of wheels & wheel diameter within a given space, to achieve the maximal load capacity. The wheel guide function, furthermore, is improved, and excellent performances are exhibited in terms of both strengths & precisions. Since a guard unit is configured on either the outer component or inner component, furthermore, interferences with the inner diameter plane of an adjacent component, etc. can be prevented even in a case where the retainer becomes slid & contacted with said adjacent component. The comet gear decelerating device of the present invention is, despite a constitution wherein needle-shaped wheels equipped with retainers are orchestrated to intervene in-between comet gears and crank axles, unaccompanied by the problem of the interferences of retainers with the inner diameters of adjacent comet gears, whereas the needle-shaped wheels equipped with retainers are excellent in terms not only of guiding functions but also of strengths & precision, and since a high load capacity can be achieved within a given space, a compact overall device constitution can be provided.

#### Brief explanation of the figures

Figures 1: (A) is a diagram which shows a partially dissected profile view of the needle-shaped wheel of the first application embodiment of the present invention equipped with a retainer,

whereas (B) is a diagram which shows a partially dissected frontal view of the same.

Figure 2: A demonstrational diagram provided for explaining a process for molding the wheel guide shape of said retainer.

Figures 3: (A) is a diagram which shows a partially dissected profile view of the needle-shaped wheel of the second application embodiment of the present invention equipped with a retainer, whereas (B) is a diagram which shows a partially dissected frontal view of the same.

Figures 4: (A) is a diagram which shows a partially dissected profile view of the needle-shaped wheel of the third application embodiment of the present invention equipped with a retainer, whereas (B) is a diagram which shows a partially dissected frontal view of the same.

Figure 5: An abstract diagram pertaining to a comet gear decelerating device designed to use the same needle-shaped wheel equipped with a retainer.

Figure 6: A diagram which shows a partially dissected profile view of the same comet gear decelerating device.

Figures 7: (A) is a diagram which shows a partial oblique view of a needle-shaped wheel of the prior art equipped with a retainer, whereas (B) is a diagram which shows a partial cross-sectional view of the same needle-shaped wheel equipped with a retainer.

(Explanation of notations)

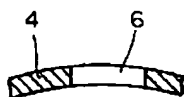
- (1): Retainer;
- (2): Wheel;
- (3) & (3B): Outer components;
- (3a): Cyclic unit;
- (3b): Guard unit;
- (4) & (4A): Inner components;
- (5) & (6): Pockets;
- (6a): Slanted plane;
- (21): Sun gear;
- (22): Carrier;
- (23): Crank axle;
- (23a) & (23b): Eccentric axle units;
- (24) & (25): Comet gears;
- (26): Input unit;
- (31): Needle-shaped wheel equipped with a retainer;
- (PCD): Pitch circle diameter.

Figures 2

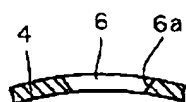
(A)

(B)

(A)



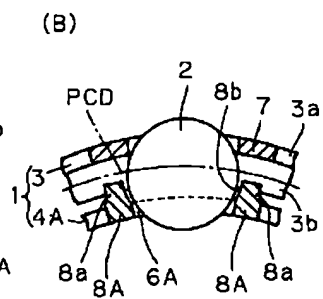
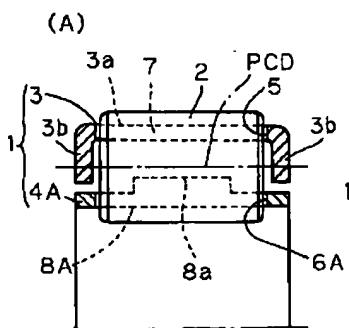
(B)



Figures 3

(A)

(B)

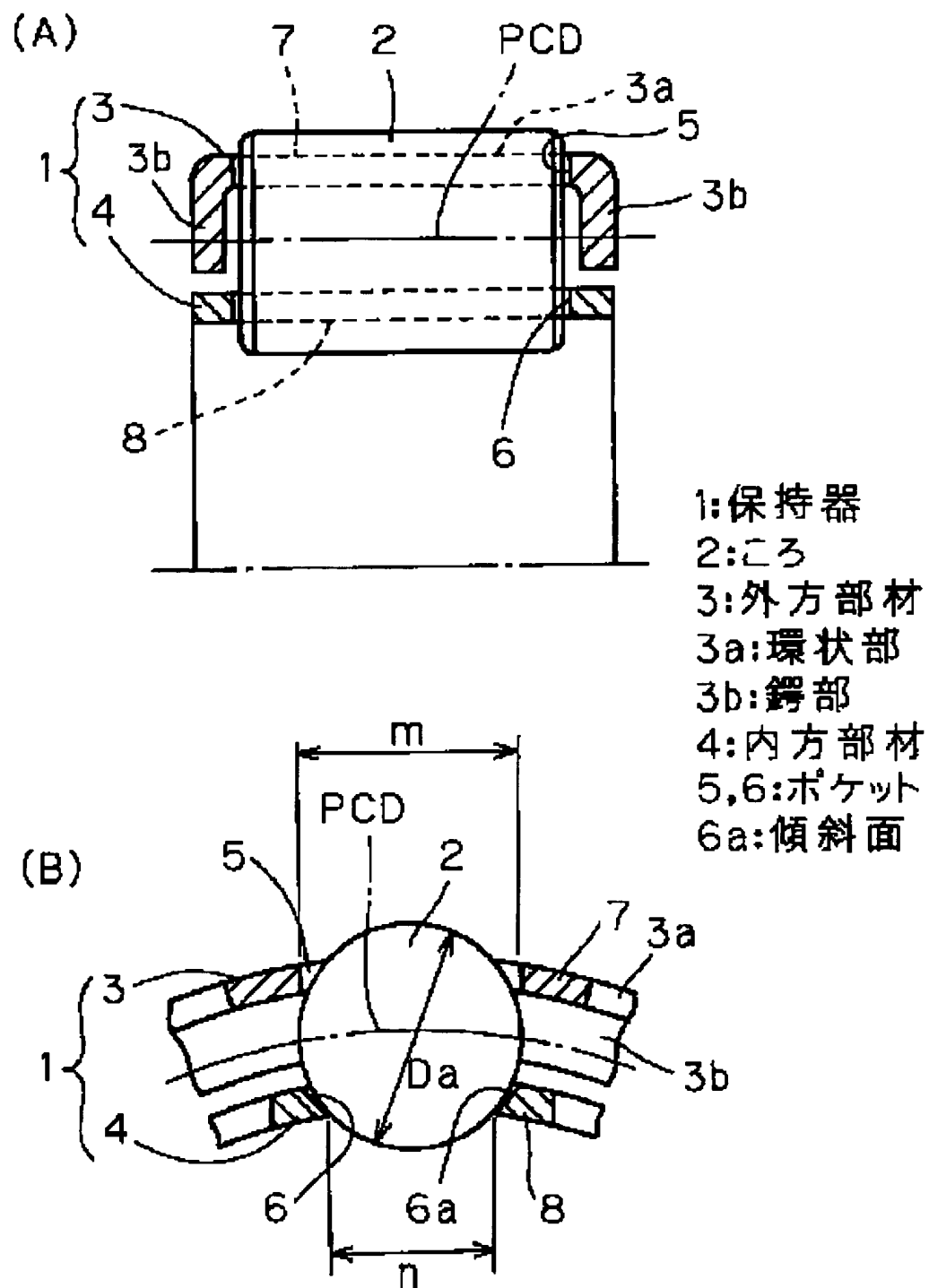


Figures 1

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(A)

(B)



[(1): Retainer; (2): Wheel; (3): Outer component; (3a): Cyclic unit; (3b): Guard unit; (4): Inner component; (5) & (6): Pockets; (6a): Slanted plane]



Figures 4

(A)

(B)

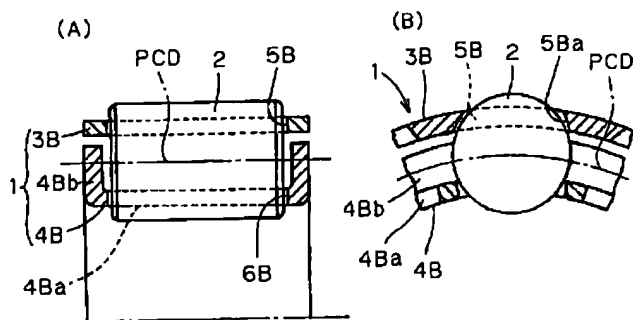
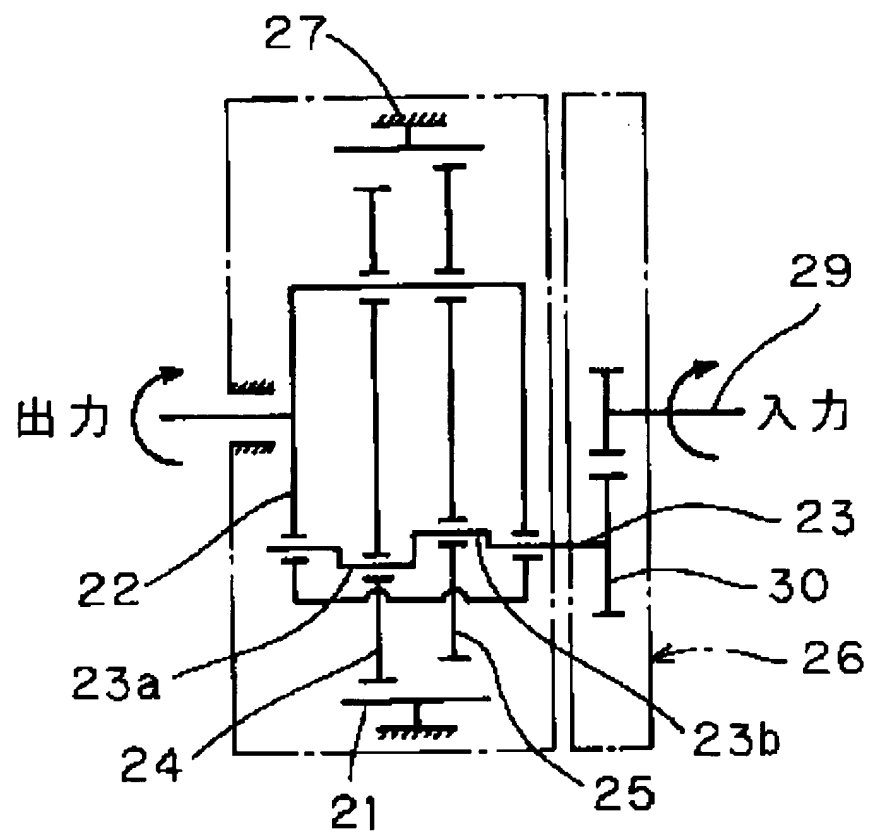
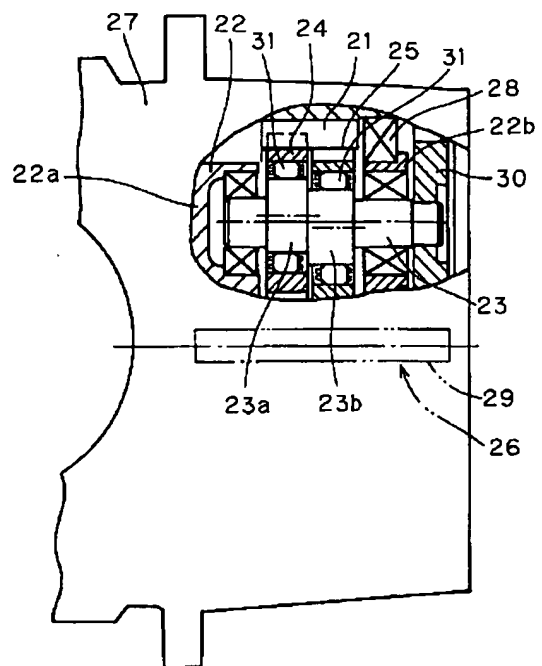


Figure 5



[(I): Input; (O): Output]

Figure 6



Figures 7

(A)

(B)

